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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
C03B 37/085, 19/02

A1

(11) International Publication Number: WO 96/38392

(43) International Publication Date: 5 December 1996 (05.12.96)

(21) International Application Number: PCT/GR95/00010

(22) International Filing Date: 2 June 1995 (02.06.95)

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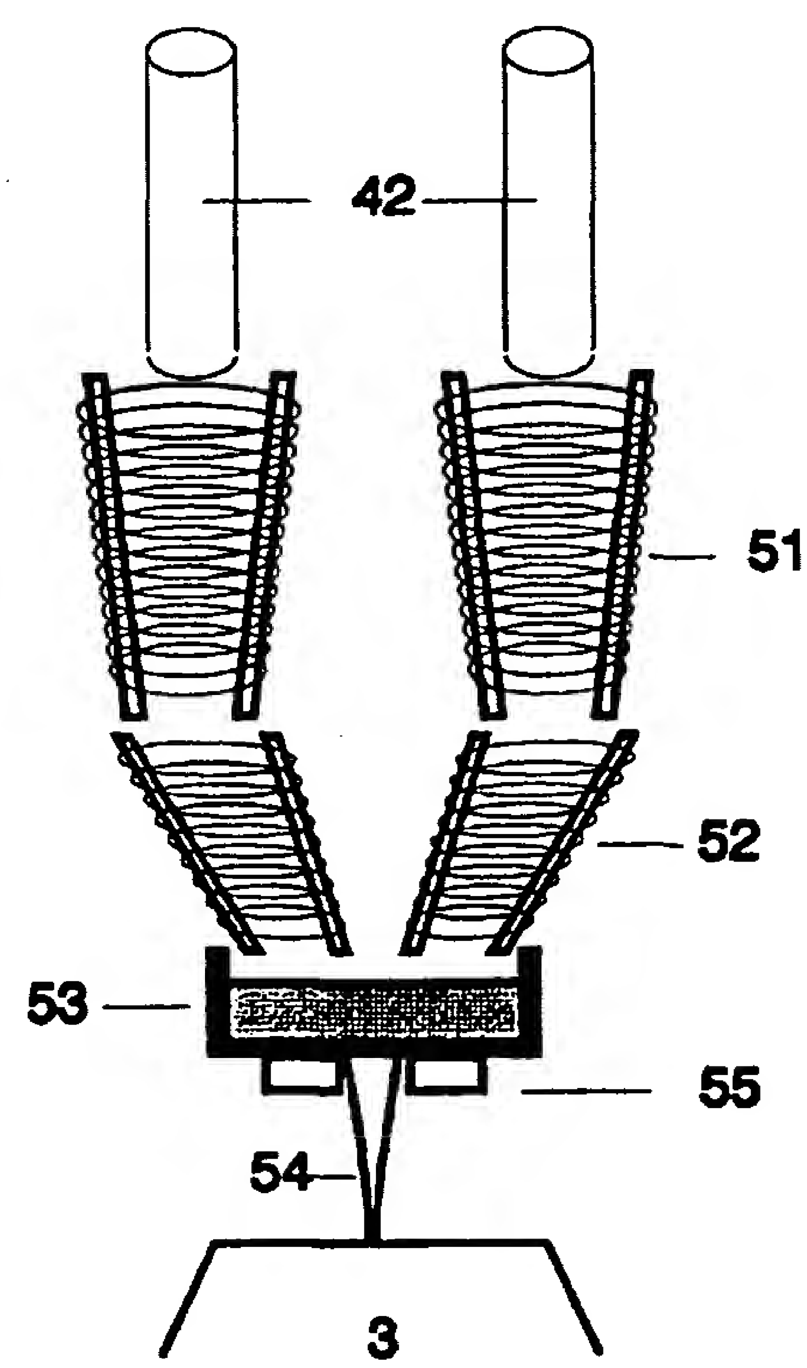
(81) Designated States: CA, CN, JP, KR, RU, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: BATCH PRODUCTION PROCESS OF FIBROUS INSULATING MATERIAL

(57) Abstract

The invention concerns a method for the production of fibrous insulating material, such as glass and mineral wool. The method of production of fibrous insulating material, comprises the steps of producing blocks of glass or minerals (42) from raw materials in a first production line comprising a melting oven for glass or mineral, and melting the said blocks (42) in a second production line other than the first production line, to produce the fibrous insulating material. The production method for the production of blocks of glass or minerals (42), which are used in the production of fibrous insulating material, comprises the steps of melting of raw materials in a melting oven, filling the liquid glass or mineral into melting forms, extracting the blocks of glass or minerals from the melting forms, and storing the blocks of materials and/or transporting them to the production site of the fibrous insulating material.



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BATCH PRODUCTION PROCESS OF FIBROUS INSULATING MATERIAL

The invention relates to a method for the production of fibrous insulating material, such as glass and mineral wool. The invention further relates to a production method for the production of blocks of glass and minerals used in the production of the fibrous insulating material.

Today, the glass wool production process is a continuous flow process which starts from raw materials which are mineral resources and ends with a final product, wrapped and labelled to be used by the final consumer on the construction site. The process starts by mixing the raw materials for the glass magma (sand, borax, soda etc.) in prescribed analogies either automatically by a system of weight scales and dosing valves, or manually into special containers.

The mix of raw materials is then forwarded automatically or manually into the glass melting oven. There at temperatures around 1300°-1450°C the different materials are melted into one magma, to produce liquid glass of the so called C-quality, which is the specific glass for the process of fibrous insulation material. These glass melting ovens can be operated either by heavy oil, by gas or electrically, according to the size of the oven, the cost of raw materials, the environment regulations etc. at a specific production site.

These glass melting ovens are constructed out of special fire resistant bricks, which need to be heated to production temperature very slowly, as to prevent their cracking. The same precautions apply also to the cooling of the bricks. The normal heating/cooling time is a matter of weeks, which is why glass melting ovens have to be operated in a continuous mode, during their whole production cycle which is typically around 4 years and is determined by the fire resistant bricks. The quality of the produced glass and the life-time of the oven strongly depend on the continuity and stability of the glass flow.

The liquid glass which comes out of the melting oven is guided through a feeder channel. The feeder channel is used to decrease the glass temperature in a controlled manner to the exact temperature that is needed for the fiberizing process, which is around 1000°C. The quantity and temperature of the glass flow from the feeder channel into the fiberizing machine can be controlled automatically or manually by the intensity of energy given into the feeder and the diameter of the glass stream.

From the fiberizing machine on, the wool is processed in a drier at temperatures around 200-300 °C to get mechanical stability, then cut into the desired width and length and packaged into the appropriate packaging material. For the production of white wool and pipewool the wool is diverted into separate lines which bypass the drier.

In case of production stops the glass which comes out of the feeder is not guided into the fiberizing machine, but is refrigerated and collected to be reused in given analogies in the raw-materials mix. Recycled glass - faulty glass from other uses - may be also added to the raw materials.

Similar methods of production are applied in the case of mineral wool, whereby the raw material is basalt and limestone.

The present invention aims at establishing a technically flawless low-cost and more efficient process for the production of glass or mineral wool. A further object of the invention is to propose a method of production of insulating material, allowing for the interruption of the production process without high cost.

The method of production of fibrous insulating material in accordance with the invention, comprises the steps of producing of blocks of glass or minerals from raw materials in a first production line comprising a melting oven for glass or mineral, and melting the said blocks in a second production

line other than the first production line, to produce the fibrous insulating material.

In accordance with the invention the method for the production of fibrous insulating material, such as glass and mineral wool, comprises the steps of melting prefabricated blocks of glass or minerals in a melting device, fiberization of the material, and drying the fiberized material to produce the insulating material.

Further in accordance with the invention the production method for the production line of blocks of glass or minerals, which are used in the production of fibrous insulating material, comprises the steps of melting of raw materials in a melting oven, filling the liquid glass or mineral into melting forms, extracting the blocks of glass or minerals from the melting forms, and storing the blocks of materials and/or transporting them to the production site of the fibrous insulating material.

The object of the invention is achieved by separating the process of production of melted glass or minerals from raw materials, from the fiberizing process for the production of glass or mineral wool. In accordance with the invention the final product, i.e. the insulating material is produced from prefabricated blocks of glass or minerals, which have been produced at a time and/or place other than the time and/or place of the production of the final product.

In accordance with the invention the melting oven is not in the same line of production with the fiberizing machine. Thus the two devices which operate in different temperatures, may work independently and they may have different production capacities. The fiberizing machine is fed with liquid glass or minerals coming out from a device, in which the prefabricated blocks of glass or minerals are melted. This latter device requires less energy input that the melting oven and may have smaller capacity. It may be constructed

from materials, which may undergo rapid temperature changes, for example changes of 1000°C in less than an hour, such as ceramics or precious metals, and not from fire resistant bricks. Thus the production may be interrupted and restarted as often as needed without problems.

The transformation of the continuous production process into a batch process offers the following advantages:

- By using the invented method it is possible to adapt the glass wool production much better at the seasonability of the sales of the product, thus gaining enormous advantages from minimisation of stock of the final product.

- The production is not any more forced to be a 24 hour/7 days a week production, allowing so the construction of small plants, with low personnel, reinforced only during the peak periods by seasonal personnel.

- The melting ovens for more than one production sites, can be concentrated in one spot, providing the local production plants for the final product, with the intermediate glass or mineral product, in form of blocks. Due to the very high density of the intermediate product in comparison to the final product, big savings in the transport costs can be achieved.

The dependent claims comprise preferable features of the invention. Among those dependent claim 3 defines that the melting device comprises an inductive heating melting cone and claim 4 that the melting device comprises two inductive heating melting cones. In accordance with claim 5 the melting device is constructed out of materials, which may undergo rapid temperature changes.

Following is the description of embodiments of the invention, whereby reference is made to the figures 1 to 5.

Figure 1a shows schematically the known production line for fibrous insulating material.

Figure 1b shows schematically the production line for the prefabricated blocks and figure 1c the production line of the final product, in accordance with the invention.

Figure 2 shows the production line of glass blocks in form of cylinders.

Figure 3 shows the melting form for glass cylinders.

Figure 4 shows the containers used for storing the glass cylinders.

Figure 5 shows the melting device for melting the glass cylinders.

Figure 1a shows the known production line for fibrous insulating material. The raw materials are fed in the oven 1 where they are transformed into glass magma at a temperature of 1300-1450°C. The liquid glass flows through the feeder 2 to the fiberizing machine 3, where at temperatures around 1000°C, the glass fibres are produced. The fibres in form of wool undergo a drying, cutting and packaging process in station 4 to reach the final product 5.

Figure 1b shows the production line for the blocks of intermediate product in accordance with the invention. The raw materials are fed in the oven 1 where they are transformed into glass magma at a temperature of 1300-1450°C. The liquid glass flows into the station 6, where the blocks of intermediate product are produced. At station 7 the intermediate product are packed and they leave the production line for storage.

Figure 1c shows the production line of the fibrous insulating material from the intermediate product in form of blocks. The blocks are fed into the melting device 8, and consequently in form of liquid glass at temperature around 1000° to the fiberizing machine 3, where the glass fibres are produced. The fibres in form of wool undergo a drying, cutting and packaging process in station 4 to reach the final product 5.

Figure 2 shows the production line of the blocks of glass used for the production of the glass insulating material. In this case the blocks are cylindrical.

The production line consists of a circular transport ribbon 21 carrying melting forms 22 (see figure 3) which are made out of fire-resistant material with a cylindrical hollow space, which can be separated in two parts to extract the solid glass cylinder.

The production line starts by supplying the glass melting oven 1 with raw materials, which are melted into magma at temperatures of around 1400°C. station 23 the liquid glass, coming out from the melting oven, is filled into the melting forms. Thereafter at station 24, a specially designed robot separates the two halves of the melting form, extracts the glass cylinder, which has the same composition as the fibres of the fibrous insulating material, and places it into the transport container. The optimum packaging density is determined by considering the easiness of operation, the security and cost of transportation.

The used containers 41 are shown in figure 4. They are made of steel, can be stored one over the other up to a height of five containers and they have removable guides for the glass cylinders 42, made of aluminium. These containers are reusable.

For the packaging of the containers a transport ribbon 25 is used so that the empty containers can be transported to station 24, where they are filled by the robot. The filled containers are then transported into the warehouse.

The prefabricated glass cylinders may at this stage be transported to the site of the production of the final product, i.e. glass wool. At this site there is a unit comprising a glass melting cone which is used to melt the glass cylinders and bring them to the temperature needed for the fiberization process.

The facility for the melting of the glass consists of two melting cones and one robot that feeds them with glass cylinders. The melting cones consist of two zones (figure 5). The first zone 51 brings the glass into liquid form. This process requires a temperature of around 700-750°C. The second zone 52 brings the liquid glass to the fiberization temperature, which is around 1000°C. Two cones are used to ensure the continuity of the fiberization in case of failure or delay of one cone. This is necessary to protect the fiberization machine from sudden stops, which shorten it's lifetime.

The melting cones, and specially the second zone are constructed out of precious metals (as platen, rhodium) to ensure the durability at high temperatures. These metals may undergo rapid temperature changes. The use of fire resistant bricks should be avoided, because of the long heating and cooling period they necessitate.

The melted glass which is at the desired temperature is concentrated at the glass collector 53. The glass flow is determined by the diameter of the flowing glass stream 54 and its temperature, that is why the bushing 55 and the second zone of the melting cone have to be in a closed loop.

The chosen form for the intermediate product is a cylinder. The cylindrical form gives energetic advantages so as to minimise the necessary energy for

it's re-melting and the size is mainly determined by the weight, so as to have a product which is easily operated.

The method may be used for all production processes where an initial energy consuming melting process is needed to produce the material which is then, following a non-interrupted production line, transformed into a final product.

The above described method is only one way to realise the invention, which is not limited to it. For example the method may be used for the production of mineral wool, from prefabricated blocks of minerals, which in their turn have been produced from raw materials in a melting oven.

CLAIMS

1. Method of production of fibrous insulating material, such as glass and mineral wool, comprising the following steps:

   a) producing of blocks of glass or minerals from raw materials in a first production line comprising a melting oven for glass or mineral,
   b) melting the said blocks in a second production line other than the first production line, to produce the fibrous insulating material.

2. Method for the production of fibrous insulating material, such as glass and mineral wool, comprising the following steps:

   a) melting of a material in a melting device,
   b) fiberization of the material,
   c) drying the fiberized material to produce the insulating material,

   whereby

   d) the said material are prefabricated blocks of glass or minerals

3. Method as in claim 2, whereby the melting device comprises an inductive heating melting cone.

4. Method as in claim 2, whereby the melting device comprises two inductive heating melting cone.

5. Method as in any of the claims 2 to 4, whereby the melting device is constructed out of materials, which may undergo rapid temperature variations.

6. Method as in claim 5, whereby the melting device is constructed out of materials, which may undergo a temperature variation of 1000° within an hour.

7. Method as in any of the claims 2 to 5, whereby the blocks of glass or minerals are cylinders.

8. Production method for the production of blocks of glass or minerals, which are used in the production of fibrous insulating material, comprising the following steps:

   a) melting of raw materials in a melting oven,
   b) filling the liquid glass or mineral into melting forms,
   c) extracting the blocks of glass or minerals from the melting forms,
   d) storing the blocks of materials and/or transporting them to the production site of the fibrous insulating material.

9. Method for the production of fibrous insulating material, such as glass and mineral wool, comprising the steps of claim 8 and the steps of claim 2.

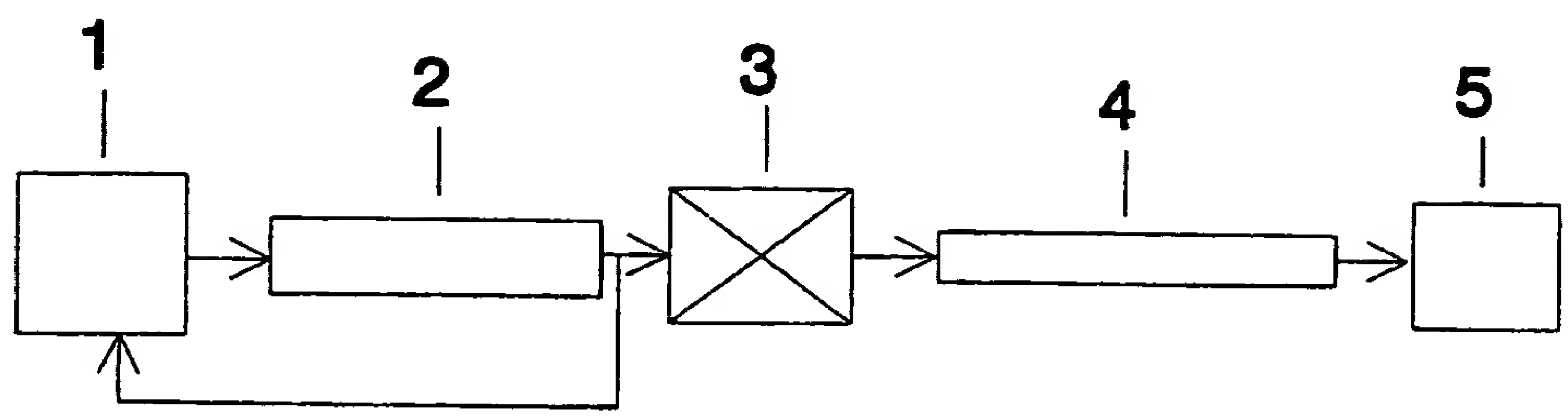

Figure 1A

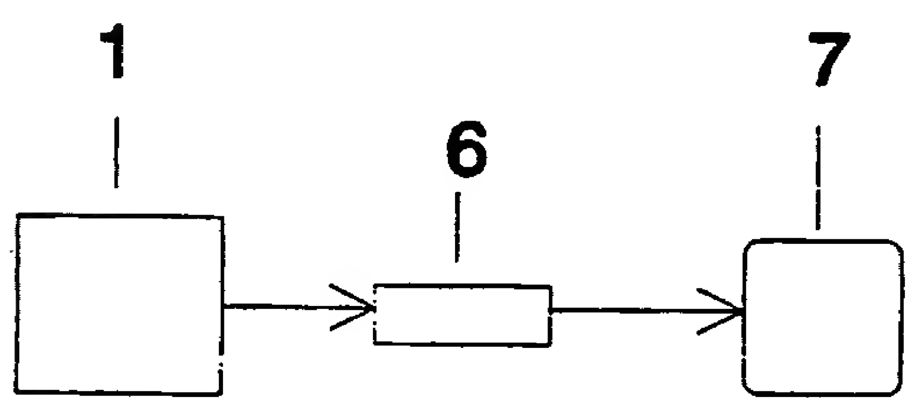

Figure 1B

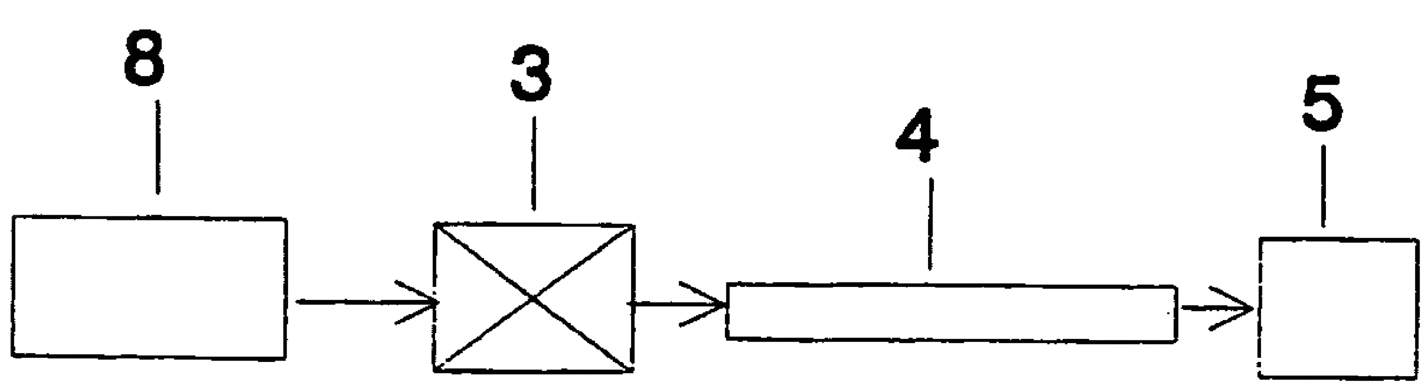

Figure 1C

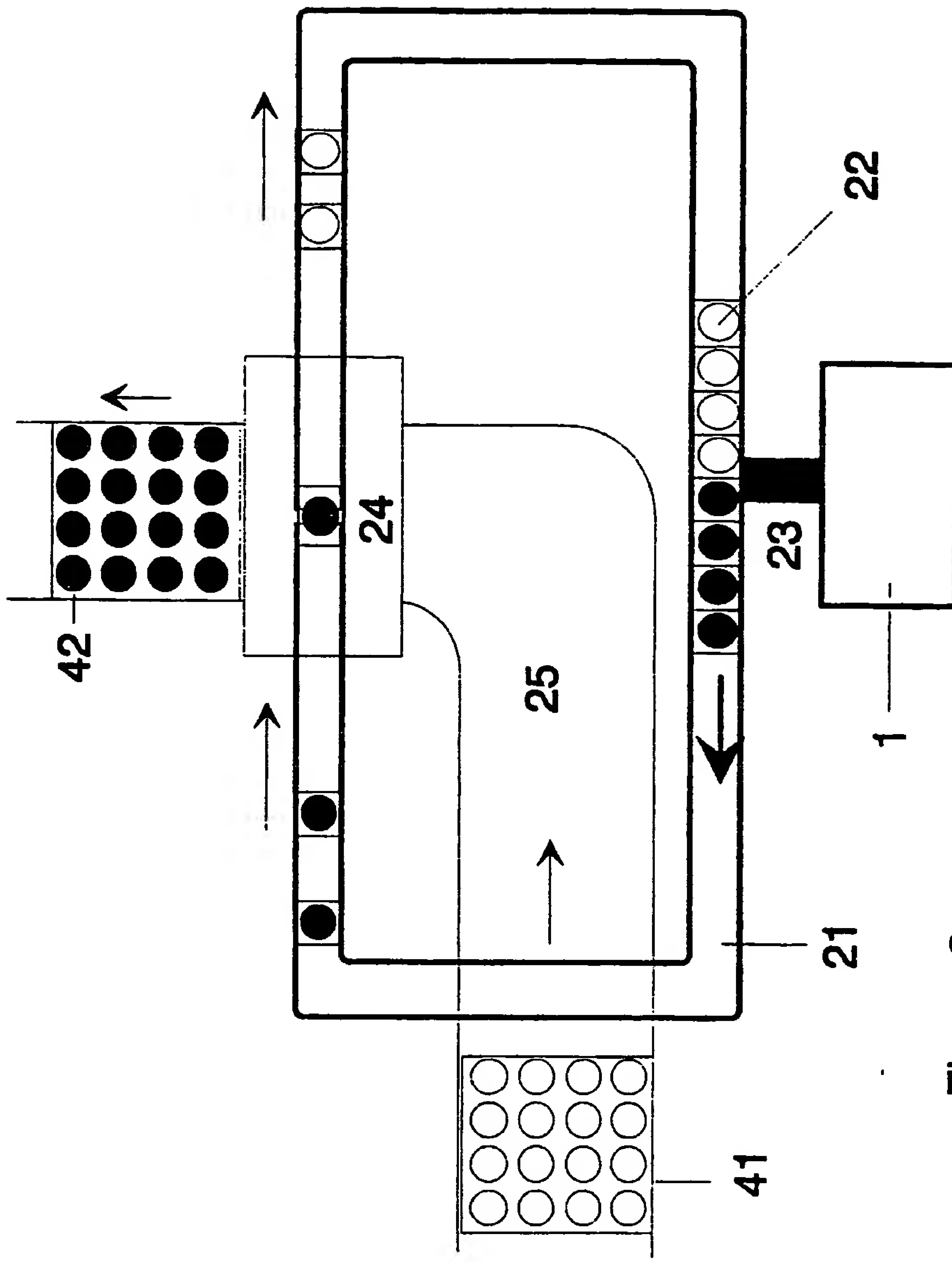

Figure 2

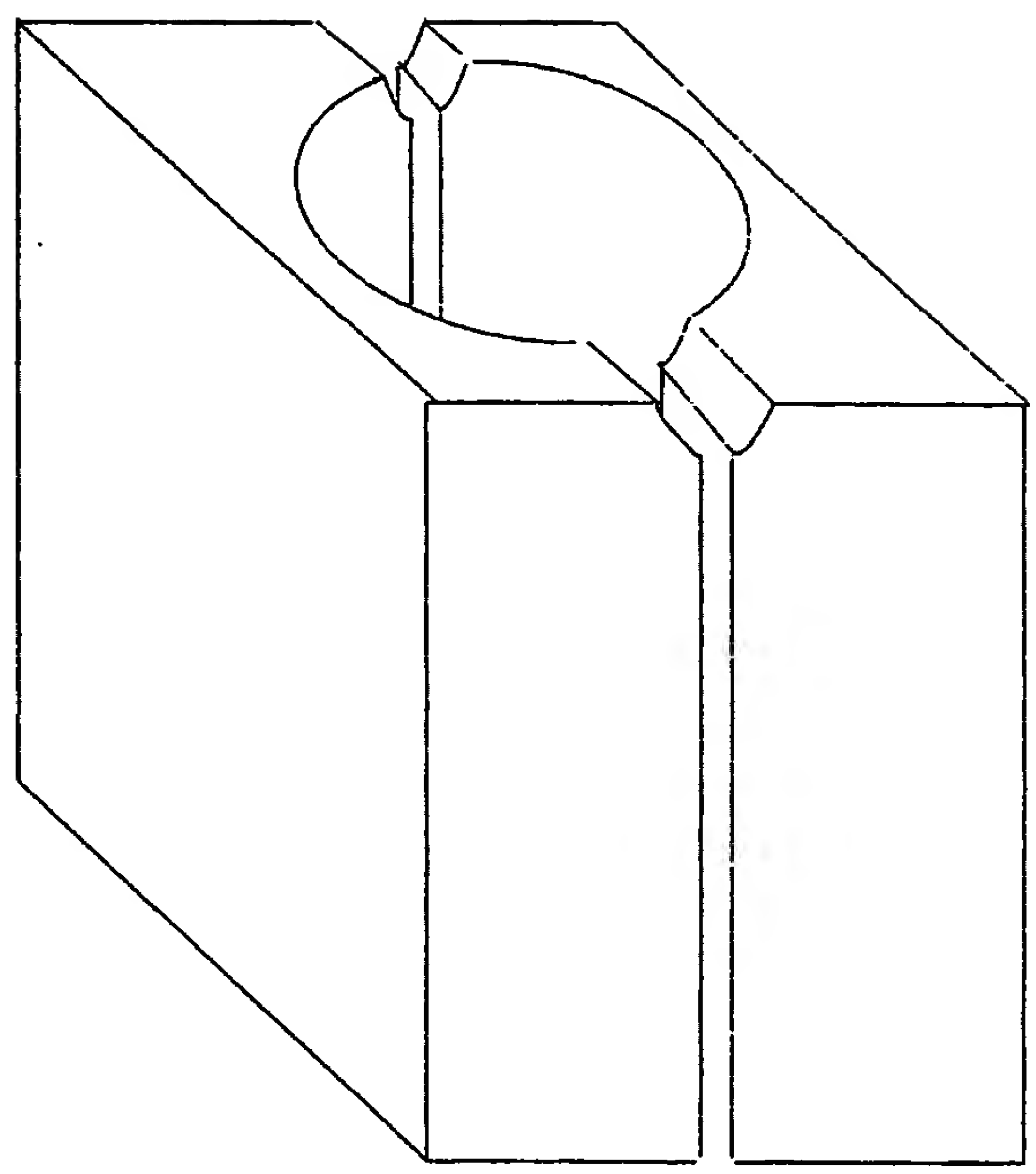

Figure 3

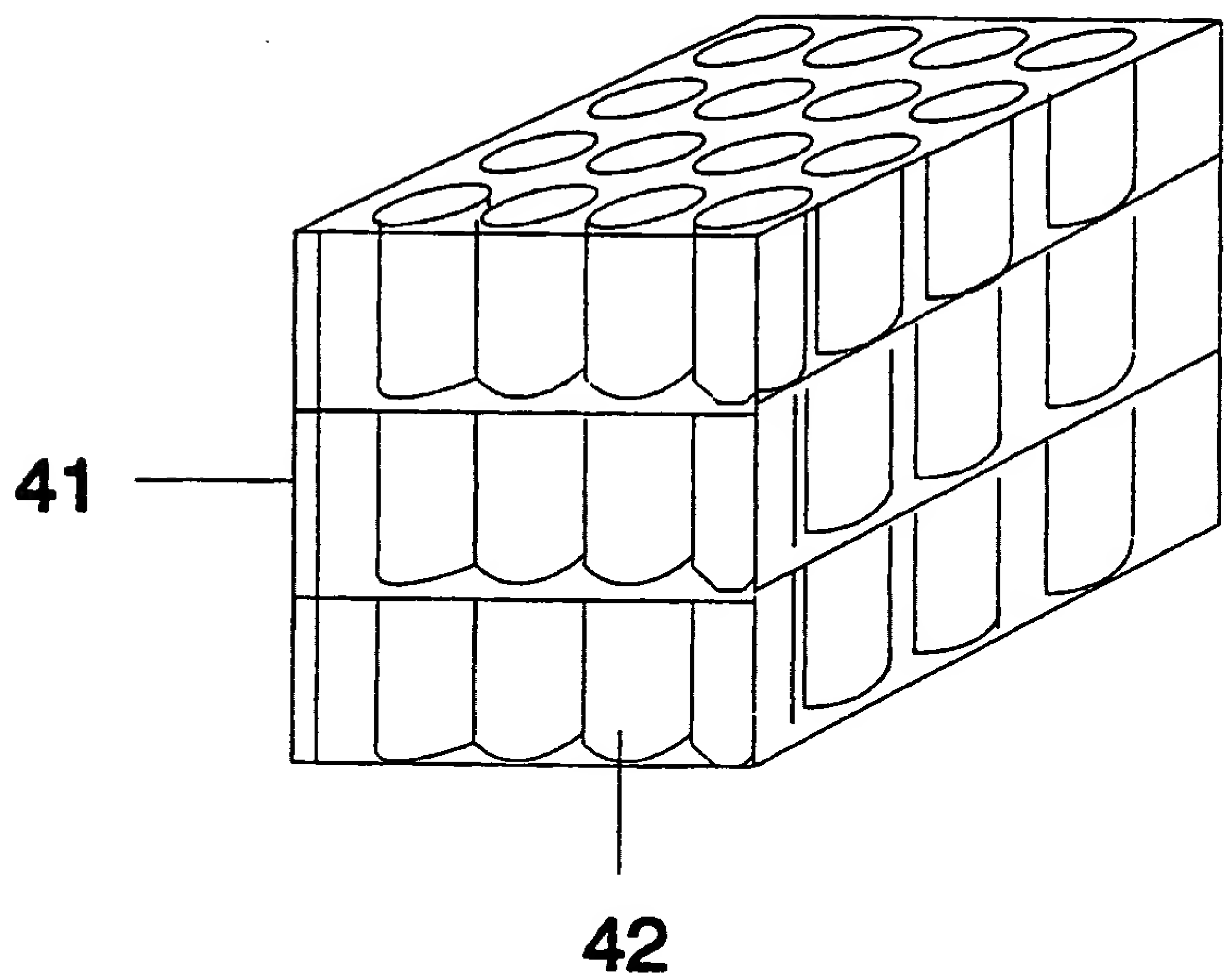

Figure 4

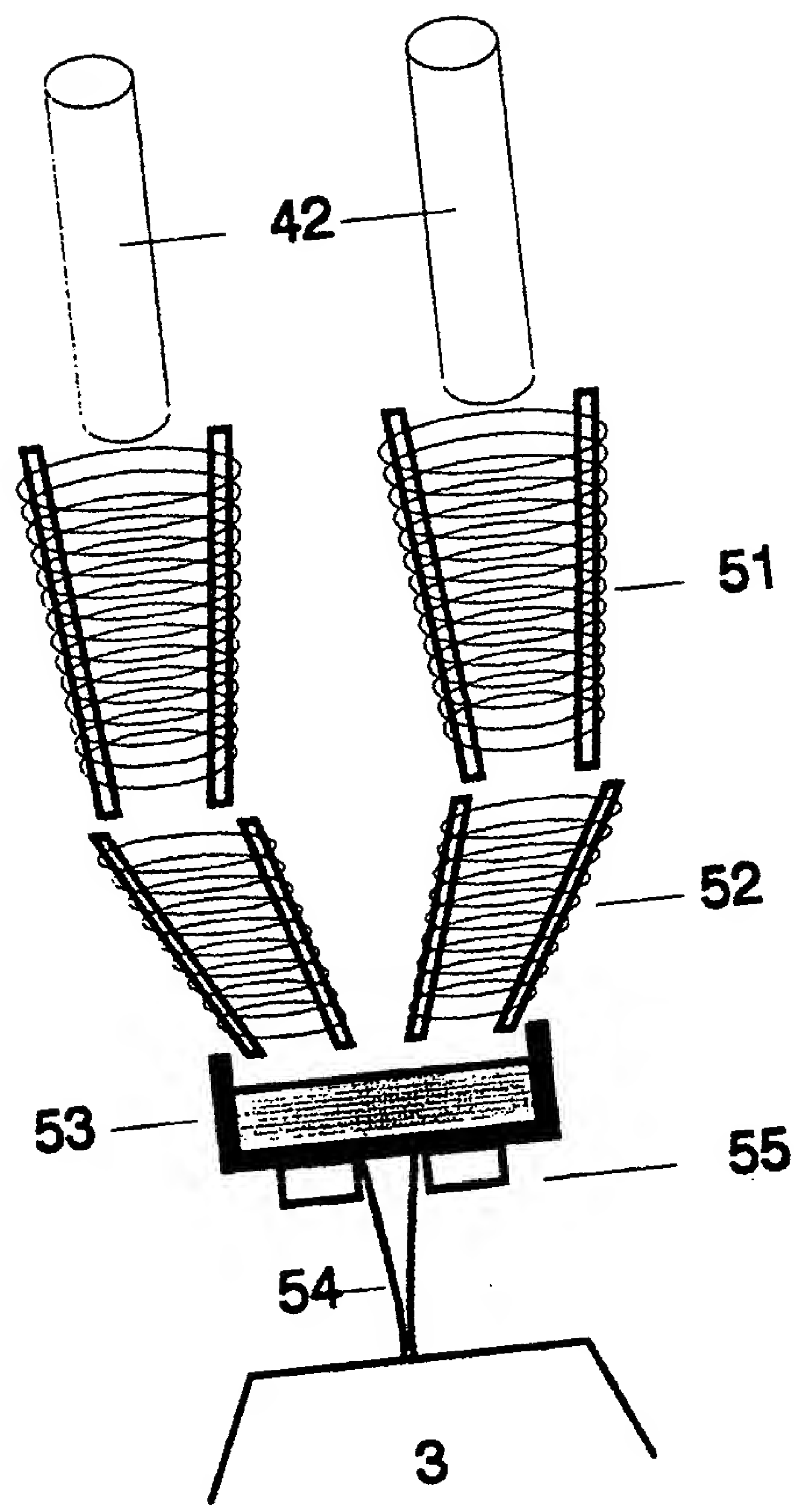

Figure 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GR 95/00010

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C03B37/085 C03B19/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 767 431 (LEWIS) 30 August 1988 see the whole document ---	1,2
X	DE,A,18 10 960 (GLASWERK SCHULLER GMBH) 17 July 1969 see the whole document ---	1,2
X	US,A,4 643 750 (GLASER) 17 February 1987 see the whole document ---	1,2
X	US,A,3 305 332 (ROBERSON) 21 February 1967 see the whole document ---	1,2,4
X	US,A,3 663 192 (WALTER MERTON PERRY) 16 May 1972 see the whole document --- -/--	1,2

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 January 1996	19. 02. 96

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